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Forest Health Protection

Northeastern California Shared Service Area

2550 Riverside Drive, Susanville, CA 96130

Special Project Report

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To: District Ranger, American River Ranger District, Tahoe National Forest

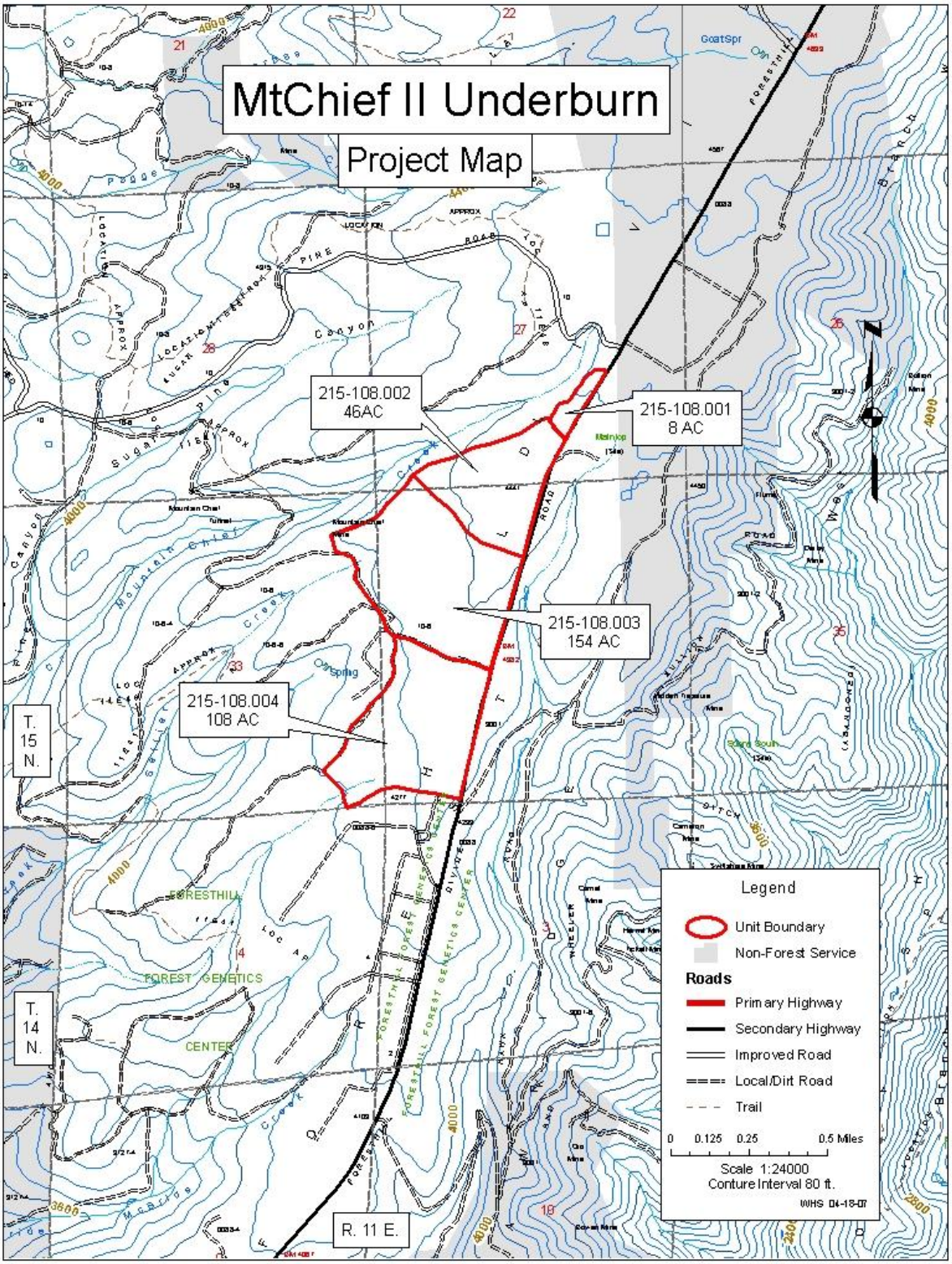
Subject: Mt. Chief II Underburn – Bark Beetle Activity and Mortality of Fire-Injured Trees (NE-SPR-12-03)

At the request of the Karen Jones, silviculturist (retired) for the American River Ranger District (ARRD), Forest Health Protection (FHP) assisted ARRD staff in setting up post-fire monitoring transects within the 2007 Mt. Chief II Underburn. These transects were designed to document the level of fire-injury to ponderosa pine, associated bark beetle activity and any subsequent mortality. As of 2009, we completed our three-year monitoring of 1,418 ponderosa pines within 21 belt transects. The Mt. Chief II Underburn provided an opportunity to obtain additional data to expand our current knowledge of the effects of fire-injury in predisposing trees to successful bark beetle attacks. This report provides a case study for the ARRD to assist in formulating future burn plans and conducting post-fire tree mortality assessments.

Summary of the Mt. Chief II Underburn Prescribed Fire Plan and Burn Conditions

The Mt. Chief II Underburn area lies within the Volcano Plantation along Foresthill Divide Road (Map 1). The forest consists primarily of ponderosa pine planted after the 1960 Volcano Fire with scattered white fir, Douglas-fir, sugar pine and black oak. At the time of the prescribed burn these pines average ~16" dbh and ranged from 10" to 26" dbh. The plantation was thinned to 20' to 30' spacing in 2001 and previously underburned in 2003. The 2003 underburn top-killed 90% of the brush (manzanita and deer brush) which subsequently re-sprouted and grew to an average of three feet in height. In addition to the brush, there was a moderate to heavy layer of needle cast on the forest floor. Ladder fuels were sparse and concentrated in a few areas in the form of tall shrubs (4 – 6 feet) that consisted of dead branches from the previous burn. Even taller brush (6 – 8 feet) was found in a few drainages crossing the units. Total fuels were estimated at 10 – 20 tons/acre. 90% of the Mt. Chief II Underburn area was on less than 10% slopes and canopy closure was between 30 – 50 %. The burn objectives included a reduction in ladder and surface fuels, increased stand heterogeneity, increased hardwood occurrence and improved wildlife

Map 1. Mt. Chief II Underburn project map.



forage. The accepted level of conifer and black oak mortality was ≤ 15% of trees greater than 10" dbh. (Mt. Chief II Underburn Rx Plan)

The burn was conducted on April 30 and May 1, 2007. Weather for April 30 was between 65 and 74 degrees, 15 to 24% humidity and winds calm to 7 mph gusts that switched directions throughout the day. May 1 weather was 61 to 67 degrees, 20 to 35% humidity and calm to 5 mph winds out of the SW. Flame lengths were 2 feet, with brush torching to 6 feet in the mornings, and 3 to 4 feet, with brush torching 6 to 10 feet, in the afternoons. The highest levels of ponderosa pine crown scorching occurred on the afternoon of April 30 when the winds were most erratic (W. Sindel, personnel communication, 2010).

Fire-injured tree monitoring

In response to concerns about the level of crown scorch and the possibility of increased bark beetle activity, FHP staff helped a ARRD crew establish 21 belt transects (66' x 660') within the four units of the Mt. Chief II Underburn on June 28, 2007. These transects represented roughly 6% of the burned area. All ponderosa pines within the belt transects were evaluated for percent crown length scorched (PCLS), percent crown length killed (PCLK) (both visually estimated) and bark beetle activity (pitch tubes, frass, woodpecker feeding and exit holes). No assessment of basal fire injury was conducted during this survey. Follow up surveys in fall 2008 and fall 2009 documented tree mortality and evidence of western pine beetle and woodborer attacks. A preliminary survey in spring 2008 documented any mortality that occurred by fall 2007. Notes were taken on the distribution of mortality (single tree or grouped) and the presence of brush and/or course woody debris in the immediate area of dead trees.

Findings

Monitoring fire-injured ponderosa pine in the Mt. Chief II Underburn revealed high levels of crown scorch in many localized pockets but overall the average percent crown length scorched was 42.2%. The average percent crown length killed was much lower (17.9%) revealing that most of the buds within the scorched portions of the crowns survived (Table 1). Red turpentine beetle (RTB) attacks were found on 12.2% of all trees but were primarily associated with trees that sustained high levels of crown injury (Tables 2 and 3). The mortality rate of all surveyed ponderosa pines was 8.0%.

Table 1. Summary of crown injury (n=1418)

Attribute	Mean	StDev	Range
% crown length scorched (PCLS)	42.2	32.3	0 - 100
% crown length killed (PCLK)	17.9	21.9	0 - 100

Table 2. Summary of beetle activity and mortality (n=1418)

Attribute	% of all trees
Red turpentine beetle (assessed two months post-fire)	12.2
Dead tree	8.0
- with western pine beetle	4.5
- with woodborer	3.5

Table 3. Percent crown length scorched (PCLS) and killed (PCLK) related to the red turpentine beetle incidence.

Red turpentine beetle	PCLS	PCLK
present	73	38
absent	37	15

Fire-injured trees began to die at the end of the first post-fire growing season (46 trees), continued through the second post-fire season (61 trees) and declined by the end of the third post-fire season (6 trees). Based on external evidence such as pitch tubes, frass/boring dust, exit holes and woodpecker feeding, western pine beetle (*Dendroctonus brevicomis*) attacks were associated with 55.7% of dead trees and woodborer (Family: Cerambycidae and Family: Buprestidae) attacks were associated with 44.2% of dead trees. The distribution of mortality was mostly grouped as opposed to scattered single trees. Mortality groups were most often associated with heavy brush, and to a lesser degree, pockets of higher tree density. Two transects with the highest levels of mortality (25% and 34%) were associated with one of the drainages that contained abundant tall deer brush.

Discussion

Monitoring fire-injured ponderosa pine in the Mt. Chief II Underburn revealed similar patterns of bark beetle activity and tree mortality to other FHP monitoring of wildland and prescribed fires in the Sierra Nevada and Cascade Mountain Ranges. First, crown injury has proven to be the most important variable in predicting tree mortality and ponderosa pines with high levels of crown scorch have a high probability of mortality (Table 4). For the Mt. Chief II Underburn, the four belt transects with the highest average PCLS (76, 69, 64 and 62%) also had the highest percent mortality (25, 20, 34 and 21%). Second, these transects also had the highest percentage of trees with red turpentine beetle (RTB) attacks (38, 43, 70 and 30%). RTB attacks are common on fire-injured pines in California. RTB activity in the Mt. Chief II Underburn mirrored other fires in that trees with higher levels of fire injury were more likely to be attacked by RTB but not all attacked trees died. Past FHP monitoring has established that the presence of RTB attacks on a fire-injured tree indicates a higher probability of mortality but it is not a stand-alone predictor of mortality [Divide Underburn (TNF), Prattville Underburn (LNF), Cone Fire (LNF), McNally Fire (SQF)]). Finally, most of the mortality in the Mt. Chief II Underburn occurred by the end of the second post-fire year, consistent with other FHP monitoring that shows that approximately 80% of post-fire mortality occurs by year two (Hood et al 2010).

Table 4. Probability of mortality with increased percent crown length scorched (PCLS) for yellow pine by DBH*

Probability of mortality →	.10	.20	.30	.40	.50	.60	.70	.80	.90
DBH	Percent crown length scorched (PCLS)								
10 - <30”	50	50	70	75	80	85	90	95	100
30 - 40”	10	25	35	40	45	55	60	70	80
>40 - 50”	--	10	15	20	30	35	40	50	65

*Table adapted from Smith and Cluck 2011

The observed levels of fire injury, bark beetle activity and subsequent mortality of ponderosa pine were within the accepted levels outlined in the Mt. Chief II Underburn plan. The observed grouped pattern of mortality also helped to create additional stand heterogeneity and provide

openings for other vegetation, including hardwoods and understory grasses and forbs. In general, prescribed burning previously thinned ponderosa pine stands in the Sierra Nevada range has not led to subsequent bark beetle problems with a few exceptions. These include the potential for heat girdling old large diameter ponderosa pines that have accumulated deep duff and litter layers around the root collar (Hood et al 2007) or ponderosa pines of any diameter that have an excessive amount of masticated wood chips near the base (Cluck 2007). The loss of large diameter ponderosa pines due to fire injury and subsequent bark beetle attack often conflicts with prescribed fire and other management objectives.

In conclusion, FHP greatly appreciates the opportunity to work with District personnel in the establishment of transects and collecting the initial crown injury data. Please contact me if you have any questions regarding this report or require further technical assistance.

/s/ Danny Cluck

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Forest Health Protection

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Citations

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